

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

GIG

009/95-00520PC

Applicant's or agent's file reference 9195-520PC	<b>FOR FURTHER ACTION</b>	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/US03/19863 ✓	International filing date ( <i>day/month/year</i> ) 23 June 2003 (23.06.2003) ✓	(Earliest) Priority Date ( <i>day/month/year</i> ) 21 June 2002 (21.06.2002) ✓
Applicant CALIFORNIA INSTITUTE OF TECHNOLOGY		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 5 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the Report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☒ **Unity of invention is lacking** (See Box II).

4. With regard to the **title**,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 13



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.



None of the figures

CZW

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/19863

## Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claim Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:  
Please See Continuation Sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☒  
☐

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/19863

## Box III TEXT OF THE ABSTRACT (Continuation of Item 5 of the first sheet)

The technical features mentioned in the abstract do not include a reference sign between parentheses (PCT Rule 8.1(d)).

### NEW ABSTRACT

Ferromagnetic semiconductor-based sensor devices (205) including sensors (210, 220) for detecting pressure changes and sensors (210, 220) for detecting magnetic fields, such as switching events in a magnetic recording medium. The pressure sensors (210, 220) detect pressure changes using magnetoresistive measurement technique, and in particular GPHE techniques. Magnetic field detection sensor (200) includes ferromagnetic semiconductor-based materials that provide enhanced sensitivity relative to known materials and techniques. Such magnetic switching detection sensors (210, 220) are particularly useful as a read head sensor for HDD and other magnetic storage technologies.

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/19863

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G01L 9/00, 16; G01B 7/14, 30; G01R 33/06

US CL : 73/754, 861.75; 324/207.2; 257/425; 360/110, 111, 81, 65

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 73/754, 861.75; 324/207.2, 216, 252; 257/425; 438/3; 360/110, 111, 81, 65

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3,818,328 (Zinn) 18 June 1974, entire document	1-27
A	US 4,816,946 (Kira et al.) 28 March 1989, entire document.	9-17
A	US 5,390,061 (Nakatani et al.) 14 February 1995, entire document.	1-27
A	US 4,618,901 (Hatakeyama et al.) 21 October 1986, entire document.	23-27

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

23 September 2003 (23.09.2003)

Date of mailing of the international search report

11 MAR 2004

Name and mailing address of the ISA/US

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**BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING**

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

- I. Claims 1-8 drawn to a pressure sensing device having a semiconductor housing structure with an opening.
- II. Claims 9-17 drawn to a method of producing a ferromagnetic semiconductor-based pressured sensor.
- III. Claims 18-22 drawn to a ferromagnetic semiconductor-based read head sensor configured to detect magnetic domain orientations.
- IV. Claims 23-27 drawn to a method of detecting changes in magnetic domain orientation in a magnetic recording medium using ferromagnetic semiconductor-based read heads sensor.

The inventions listed as Groups I, II, III, and IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical feature of the Group I is a structure of a pressure sensing device with a housing having an opening; a ferromagnetic semiconductor Hall bar gage structure produces a signal responsive to a deflection of the membrane. The special technical feature of Group II is to fabricate a ferromagnetic semiconductor-based pressure sensor with the steps of laying and sealing the cavity. The special technical feature of Group III is to detect magnetic domain orientations in a magnetic recording medium having first and second read current contacts being configured to provide electrical current flow along the hard axis. The special technical feature of Group IV is method of detecting changes in magnetic domain orientation in a magnetic recording medium using ferromagnetic semiconductor-based read heads sensor having the step of moving the head and detecting changes in the transverse magnetic resistance of the epilayer. The four Groups I, II, II, III, and IV, as previously discussed, do not share the same special technical feature.